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FM 31-35

WAR DEPARTMENT

BASIC FIELD MANUAL

AVIATION IN SUPPORT OF GROUND FORCES

April 9, 1942

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FM 31-35

BASIC FIELD MANUAL

AVIATION IN SUPPORT OF GROUND FORCES

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FM 31–35, Basic Field Manual, Aviation in Support of Ground Forces, is published for the information and guidance of all concerned.

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BY ORDER OF THE SECRETARY OF WAR:

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BASIC FIELD MANUAL

AVIATION IN SUPPORT OF GROUND FORCES

(This manual supersedes section III, Training Circular No. 39, Training Circular No. 52, and air support references in Training Circular No. 70, War Department, 1941, and other doctrines and training methods in conflict herewith.)

CHAPTER 1

GENERAL

PURPOSE AND SCOPE

■ 1. The purpose of this manual is to prescribe organization for combat, general functions, and employment of aviation used in tactical support of ground forces. Only matters of common interest to both the air and ground forces are covered. For basic doctrine of air force employment see FM 1–5 and 100–5.

■ 2. *a.* Aviation in support of ground forces is normally constituted into air support commands which are ordinarily component parts of air forces. There is usually an air force, including a bomber command, an interceptor command, an air support command and an air force base command, assigned to each theater of operation. An air support command is habitually attached to or supports an army in the theater.

b. Observation type aviation is organic to an air support command; other types are assigned or attached as the situation requires.

■ 3. The tactics and technique as set forth in the following War Department publications amplify and supplement this manual:

a. Air attack.—FM 1–10.
b. Air fighting.—FM 1–15.
c. Air reconnaissance and observation.—FM 1–20.
d. Airdrome defense.—FM 100–15.
e. Air signal communication.—FM 1–45.

DEFINITIONS

■ 4. *a. Air alert.*—That status in which aircraft is in the air, armed and serviced for the immediate execution of an air mission.

b. Ground alert.—That status in which aircraft on the ground is fully serviced, armed and with combat crews in readiness to take off 15 minutes after receiving orders to perform a mission.

c. Ground readiness.—That status wherein aircraft can be serviced and personnel alerted to leave the ground for a mission within 2 hours.

d. Airplane status report.—A periodic report showing airplanes available for a certain specified period. Their status of readiness is indicated.

e. Air support command.—A tactical air organization, organized, equipped, and trained to render air support to ground forces normally supporting an army.

f. Air support control.—The air unit at the headquarters of the supported unit for the purpose of controlling the operations of the support aviation; advising the supported ground commander as to the capabilities of the air unit; and maintaining liaison with the air units.

g. Air support officer.—An air officer with a ground combat element as a representative of air support control. For functions see paragraph 37.

h. Air support party.—A highly mobile group composed of one or more air support officers and necessary personnel and equipment to transmit air support requests to air support control, and to operate communications with aircraft-in-flight net. For functions see paragraphs 37 and 109.

i. Air support missions.—Missions assigned air support aviation include both the immediate support of ground forces where contact with the enemy is imminent or has already been established, and the destruction or neutralization of timely but more distant targets to prevent or impede hostile movement, intervention or entry into combat. (See pars. 26–34.)

j. Briefing.—The act of furnishing airplane crews with the latest essential information in the briefest possible form immediately prior to the take-off.

k. Objective folder.—A compilation, in convenient folder form, of data for planning and executing a mission in support of ground units.

CHAPTER 2

COMBAT AVIATION

SECTION I

ORGANIZATION

GENERAL

■ 5. In addition to his duties as commander of support aviation, the air support commander acts as adviser to the ground commander. He normally functions under the army, theater, or task force commander.

■ 6. Aviation units may be designated in support of a major ground force. The control is centralized in an air support commander who assigns the attack missions as the needs of the ground unit(s) develop. When the operation requires, aviation units may be specifically allocated to the support of subordinate ground units. When this is done the combat aviation unit receives its support missions from an air support control established at the command post of the supported unit. However, a combat aviation unit may also receive other support missions from the air support commander. Designation of an aviation unit for support of a subordinate ground unit does not imply subordination of that aviation unit to the supported ground unit, nor does it remove the combat aviation unit from the control of the air support commander. It does permit, however, direct cooperation and association between the supporting aviation unit and the supported ground unit and enables the combat aviation to act with greater promptness in meeting requirements of a rapidly changing situation. Aviation units may be *attached* to subordinate ground units. This is exceptional and should be resorted to only when circumstances are such that the air support commander cannot effectively control the combat aviation assigned to the air support command.

■ 7. The agencies and channels of tactical control of combat aviation of a typical air support command are charted in figure 1. In this case an air support command is repre-

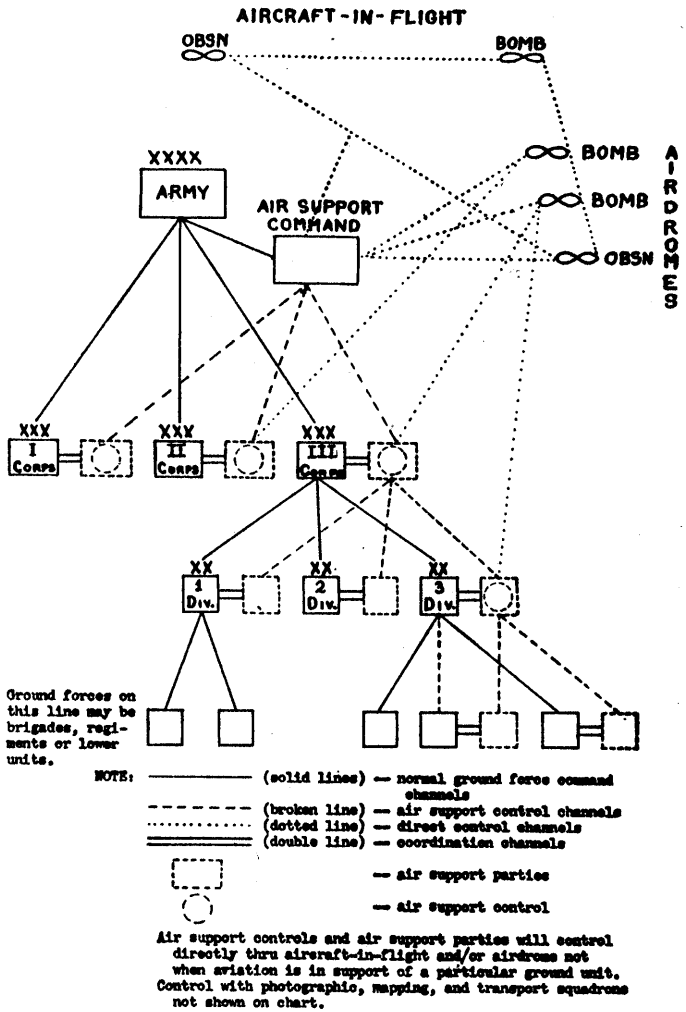

FIGURE 1.

sented in support of a ground force consisting of an army. Agencies and channels of tactical control are shown in only one corps. An air support control is associated with the command post of each of the three corps and 3d Division of the III Corps. Air support parties are allocated to the III Corps as follows:

3d Division—Two with lower units.
2d Division—One with division headquarters.
1st Division—One with division headquarters.

For signal communication see chapter 5.

■ 8. The command post of the air support command is immediately adjacent to the command post of the supported unit—in this case an army. A representative of the ground commander of the supported units is always present at the air support command post. An air support liaison officer will always be at the command post of the supported unit.

■ 9. Figure 1 also illustrates channels of air support control.

a. From the various air support parties and controls to the air support command post (broken lines). It should be noted that the attack order will go from the first control directly to airdrome.

b. From the air support command post to the various airdromes and to aircraft in flight either directly or through the airdromes (dotted lines).

c. From air support parties to air support control and then directly to airdromes when in support of a specific ground unit, such as a division.

EMPLOYMENT

■ 10. COOPERATION.—The basis of effective air support of ground forces is teamwork. The air and ground units in such operations in fact form a combat team. Each member of the team must have the technical skill and training to enable it to perform its part in the operation and a willingness to cooperate thoroughly.

■ 11. FACTORS AFFECTING EMPLOYMENT.—The most effective employment of support aviation requires a consideration of many factors:

a. Local air superiority.—Local air superiority must be maintained to insure air support without excessive losses due to hostile aviation.

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b. Economy of force.—This does not mean economy in numbers of airplanes applied to the objective, but economy of force by application to the right target at the right time. Aircraft are more vulnerable and less easily replaced than artillery. Only those targets which cannot be effectively and quickly reached by artillery should be assigned to supporting aviation.

c. Time and space.—Consideration of time and space factors involve an appraisal of the mission, the distance from the airdrome to the point of action, the speed and reliability of signal communication, and the status of readiness of aircraft assigned to the effort.

d. Flexibility.—Flexibility is the ability to concentrate the air effort at short notice on a particular point or distribute it to many points within a relatively short time.

e. Limitation of aircraft.—Air support cannot be guaranteed. It may be limited by weather, enemy action, or mechanical failure.

f. Field of operation.—The area of operation of support aviation should not be restricted but should be sufficiently broad to permit timely attacks on enemy forces that jeopardize the success of operations of supported forces.

g. Weight of attack.—Weight of attack depends upon the number of aircraft employed and the rate at which operations can be conducted. Security and avoidance of losses in the execution of attacks must be subordinated to the achievement of the maximum demoralization and destruction of the enemy.

h. Air cooperation.—Close cooperation and coordination with other air force elements in the same area are necessary. If operating outside the area of an effective interceptor command, the air support command should have made available to it sufficient pursuit aviation.

■ 12. METHODS OF EMPLOYMENT.—The ground force commander, in collaboration with the air support commander, decides the air support required. The following are general methods for employment of combat aviation:

a. All combat aviation initially assigned to support of the major ground force with provisions for certain subordinate unit support assignment later.

b. A part assigned to support of the major ground force with the remainder assigned to support of subordinate elements.

c. Assignment of all combat aviation to support of the major ground force with provisions for a change to specific subordinate unit support while the aircraft are in flight.

d. All combat aviation assigned initially to support of subordinate units with provisions for control or target designation by certain units directly from an air support control or an air support officer to aircraft in flight.

SECTION II

INTELLIGENCE

GENERAL

■ 13. The importance of military intelligence to the employment of support aviation is vital. Without factual knowledge of hostile activities and installations the effect of air support missions is minimized and in many cases nullified.

■ 14. High standards of ability and training are required of intelligence personnel. Many are specialists in a particular branch of military intelligence. Of particular importance in this duty are the specialists in the interpretation of aerial photographs.

■ 15. The intelligence section of the air support command post operates in conjunction with the operations section. Under such circumstances it is able to furnish the air support commander with timely and accurate information concerning the enemy capabilities, after considering the objective and the hostile activities, as influenced by weather and terrain.

■ 16. Military intelligence procedures and objectives are described in FM 1–40 and 30–5.

SOURCES OF INFORMATION

■ 17. All possible sources of information, ground and air, are utilized to obtain air support intelligence. Important sources may be—

a. Visual reconnaissance.

b. Photographic reconnaissance.

c. All air units in the locality.
d. Air warning and antiaircraft units.
e. Captured matériel, personnel, and documents.
f. Intelligence sections of ground units.
g. Air support parties and controls.
h. Intercepts.

■ 18. Intelligence officers stationed at airdromes secure much important data by thoroughly questioning crews as they return from air missions. In addition these airdrome intelligence officers are charged with the mission of keeping the flying personnel abreast of the situation as fully as possible, utilizing the periods between missions to the fullest extent, and thus shortening the time of briefing combat crews immediately prior to departure on missions.

■ 19. Ground troops should be thoroughly indoctrinated to report all bombardment or machine gun attacks by enemy aviation. The tendency of individuals and echelons undergoing air attack is to become engrossed in warding off the attack and forgetting to make a full report of the attack to intelligence agencies.

COLLECTION, EVALUATION, AND DISSEMINATION

■ 20. Intelligence officers of all echelons must be trained to grasp the decisive elements of a situation, to evaluate the information obtained, and to prepare it for use.

■ 21. Objective folders are prepared, in advance whenever possible, to apply to all possible objectives in the area of operations and in probable air theaters. In most cases the opportunity for air activity prior to actual combat will be limited, and the preparation of objective folders will have to be accomplished during the conduct of operations.

■ 22. Close cooperation between all intelligence agencies, ground and air, must be achieved to provide timely knowledge of essential information by all concerned. Occasions arise where vital items of military intelligence to air units must be routed directly between air units without resort to normal channels. Such action must be taken when the situation justifies it.

■ 23. All enemy information must be evaluated so that proper conclusions may be derived therefrom.

■ 24. Dissemination of intelligence to individuals or units must be made according to the urgency of the subject matter. Immediate transmission of all intelligence data would congest the communication facilities. Therefore, it is of prime importance that matters which can be delayed be held for periodic reports.

SECTION III

COMBAT OPERATIONS

CONDUCT

■ 25. Combined operations of air and ground forces must be closely coordinated by the commander of the supported ground force. All operations should therefore be conducted in accordance with well-defined and practical plans. (See FM 100–5 and 100–15.)

MISSIONS

■ 26. Combat support aviation may be employed on the following types of missions:

a. Reconnaissance bombardment.—Bombardment aviation may conduct combined reconnaissance bombing missions by developing and attacking targets located by the mission.

b. Attack on defensive organizations.—Air attacks are executed against field fortifications and defensive organizations in the path of the supported ground forces, particularly mechanized and armored forces, when it is not practicable to employ other means of attack upon the desired objective in the time available, or when the added fire power and moral effect of air attacks are essential to insure the timely success of the ground force operation.

c. Attacks on enemy reserves and reinforcements.—Hostile ground forces moving toward the operation area of the supported force normally will be a remunerative target for bombardment aviation and should be subjected to air attack for the purpose of blocking or delaying their movement and for effecting their destruction or demoralization.

d. Attacks on hostile mechanized forces.—Supporting combat aviation attacks and destroys approaching mechanized forces and antitank units before they gain contact with the supported force. The supply and maintenance elements so essential to motorized and armored formations should be sought constantly.

e. Attacks on hostile aviation.—When other air forces are inadequate or not available, the destruction or neutralization of hostile aircraft or antiaircraft by support aviation may be necessary.

f. Support of parachute and other air-borne troops.—In the support of this type of operations, friendly pursuit operates to gain and maintain effective air control over the objective for the period of the operation and provides security to air-borne troops while in air transit and during landings. Supporting bombardment aviation conducts initial attacks when necessary to neutralize the enemy ground defenses at or near the objective and maintains sustained support until the objective of the supported unit has been gained. Air attacks are directed against ground targets at or near the objective that oppose the operations of the supported air infantry on the ground and against enemy reserves or reinforcements that threaten the supported force.

TARGETS

■ 27. Unless the situation is critical, targets usually will not be selected within the effective range of the weapons of ground forces. (See par. 26*b*.) Small targets due to dispersion, camouflage, or concealment are not suitable targets for support aviation. Commanders must consider the employment of combat aviation in the light of the hostile air and ground situation and not as a weapon which can be applied with equal value in all circumstances.

■ 28. Air support targets on the immediate front or flanks of supported units are generally transitory targets of opportunity. These targets may include troop concentrations or movements, artillery in position or in motion, minor field fortifications such as pill boxes, armored forces and tanks in assembly or in motion, motor columns, bridges of military value, and various field installations. The employment of dive bombers is indicated against these targets.

■ 29. Air support targets not on the immediate front or flanks may include command posts, lines of communication, ammunition and bomb dumps, troop concentrations in bivouac or on the march, airdromes and aircraft thereon, tank concentrations, etc.

■ 30. Rules cannot be laid down for the selection of the type of aviation to be employed against certain types of targets. The method of attack and equipment to be used must be determined by the air support commander or air support control after a consideration of all the factors affecting the employment of available aviation in the particular operation.

■ 31. The most important target at a particular time will usually be that target which constitutes the most serious threat to the operations of the supported ground force. The final decision as to priority of targets rests with the commander of the supported unit.

■ 32. Secondary targets should be assigned in each attack mission in case the primary target cannot be attacked.

■ 33. Targets may be developed by ground reconnaissance or air reconnaissance and aerial photography.

■ 34. Targets must be accurately indicated to the attacking aircraft. Targets may be designated by—

a. Use of maps and map substitutes with well-understood grid systems or with a coded template.

b. Marked aerial photographs, either vertical or oblique.

c. Polar coordinates with reference to a terrain feature which can be identified from the air.

d. "Leading in" of combat aviation by observation aircraft.

e. Visual ground signals such as—

(1) Arrow or "V" on ground pointing to target with range indicated by proper number of crossbars or disks, each representing a definite distance.

(2) Vehicles in prearranged formations.

(3) Firing tracer ammunition or artillery or mortar smoke to mark a reference point.

(4) Signal lamps and lights.

(5) Pyrotechnics.

f. All ground units must be trained so as to assist air units in every way possible in reaching their target.

PLANS AND ORDERS OF GROUND AND AIR COMMANDERS

■ 35. GROUND COMMANDERS.—In addition to normal data concerning reconnaissance and intelligence missions, the field

orders of the supported commander should contain at least the following instructions to air support aviation:

a. Mission of support aviation.

b. Method of air support.

c. Designation of units to receive direct support.

d. Area in which support aviation is to operate or be prepared to operate.

■ 36. AIR COMMANDERS.—*a.* The air commander must be so trained in the tactical employment of elements of his command that, given a specific objective, he can evolve a plan of action to fit the situation at hand. However, the situation may change prior to arrival at the objective, in which case the secondary plan of action will be put into effect.

b. The air support commander will issue complete orders when time permits, but normally the instructions will be in fragmentary form or according to a prearranged form. The following items are necessary for lower air units to enable them to prepare for operations:

(1) Assignment of units to support the ground force, including priority, limiting times of attack, bomb loading, routes, and aviation assistance.

(2) Instructions to units detailed for support of particular subordinate units.

(3) Necessary instructions as to bomb loadings.

(4) Instructions concerning bomb safety lines with effective time limits.

(5) Assignment of missions to observation units.

(6) Allocation of air support control and air support parties.

(7) Special signal communication instructions.

c. Air support to carry out both ground and air commanders' orders in the case where a unit is specifically assigned to the support of a particular ground unit, such as a division, will be carried out in accordance with the procedure and control as outlined in paragraph 37.

AIR SUPPORT MISSION PROCEDURE

■ 37. INITIATION OF REQUESTS.—*a. General.*—Requests for air support originate with any unit commander and follow normal command channels until they reach a command post where

there is an air support party. The commander initiating the request will include the following information:

(1) Type or designation of target.

(2) Exact location of target by best means available. (See par. 34.)

(3) Direction of movement of target.

(4) All particularly distinguishing characteristics of target.

(5) Location of friendly troops with respect to target.

(6) Time limits of requested support if necessary.

b. Transmission of request.—At the air support party the air support officer will advise the commander of the ground unit with which he is operating as to the practicability of execution of a mission and as to the advisability of requesting it. If the ground commander approves the request it will be forwarded without delay to the air support control.

c. Evaluation of request.—At air support control the air support officer in collaboration with the commander of the supported unit evaluates the request considering the following factors:

(1) Identification of target and location.

(2) Time limits of attack.

(3) Importance of target in furtherance of ground plan.

(4) Number of airplanes required to destroy or neutralize the target.

(5) Number of airplanes available at airdrome and their status of readiness.

(6) Weather conditions along route and at target.

(7) Type of bombs and ammunition required.

d. Decision on request.—The decision as to whether or not an air support mission will be ordered rests with the commander of the supported unit. Such decision must comprehend full consideration of the air support commander's advisement as to air means available and the ability of aviation to perform successfully the mission ordered. (See par. 109.)

e. Notification of decision to source.—When the decision has been reached as to whether or not the mission will be ordered, the air support control will in all cases advise the requesting unit through the air support party as to the action taken, stating reasons if mission is not ordered.

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f. Transmission of orders.—If the request is approved it will be forwarded in attack order form directly to airdrome of supporting unit for compliance.

g. Air action on orders.—Upon receipt of an attack order, the unit at the airdrome will take the necessary action in conformance with its state of readiness to insure success of the attack.

h. Air report on execution of support mission.—Immediately upon return of the airplanes to the airdrome, the air unit commander will report directly to the air support control where the order originated, giving results of mission and all pertinent intelligence data.

i. Ground report on result of attack mission.—After the attack by support aviation, the commander who requested the support will report results of attack to air support control through the same channels that were used for the original request.

j. Priority status of requests.—Requests for air support should have priority over all other matters on the air support control net. See paragraph 114 for suggested forms for messages and attack orders.

ATTACKS

■ 38. The approach, formation, altitude and delivery of attack are matters of technique for the supporting air units concerned and are beyond the scope of this manual.

■ 39. TIMING.—*a.* The timing of the air attack is of primary importance in securing the maximum effect.

b. When friendly troops might be endangered, definite time limits for the commencement and termination of the attack should be prescribed. Time allowances for action upon air requests, the transmission of the attack order through channels, the aircraft to leave the ground, and for the flight to the objective must be carefully computed in determining the time of attack.

c. When the nature of the attack permits, the firing of prearranged flares by the last element of the combat aviation may serve to signal the end of the air attack as well as a signal to launch the ground attack. The ground attack may be launched on the signal from the combat aviation or at the end of the time bracket, whichever comes first.

d. In some cases the exact time a target may be most exposed or attacked to greatest advantage cannot be fixed when the attack order is given. In such cases an attack may be ordered when a particular condition occurs (crossing bridges or exposed area, debouching from cover, within a defile, etc.) rather than at a precise time.

■ 40. TYPES OF BOMBS.—*a.* Bombs that are most generally used by support aviation are—

(1) Fragmentation.
(2) Demolition from 50 pounds to 250 pounds.
(3) Chemical.
(4) Incendiary.

b. The most effective bomb in any instance depends on the target against which it is used.

STATUS OF AIR UNITS

■ 41. In support operations when targets cannot be foreseen and developed sufficiently in advance for normal air operating procedure, special provision must be made to minimize the time lag between requests for missions and their execution. Frequently such targets will be encountered in a fast moving ground situation wherein time will be the vital factor in any air operations conducted.

a. Alert status.—To meet this time requirement, a suitable portion of supporting combat aviation should be maintained on "alert" status, either ground or air, prepared to proceed to and attack, with the least practicable delay, any assigned target. This will necessitate that the aircraft previously be armed and serviced. In this connection, it is highly desirable in support operations that the number of types of loading be restricted to one or two except for a special operation.

(1) When aircraft are ground-alerted, the pilots station themselves in the immediate vicinity of the unit operations office or their aircraft, ready to receive final instructions. Procedure should be developed to minimize the time required to clear the airdrome after instructions and orders are issued.

(2) In fast moving situations when "ground alert" does not permit timely attacks, it may sometimes be necessary to "air alert" a portion of the supporting force for the attack of targets of opportunity that constitute an immediate threat to the operations of the supported ground force. Air alert

is highly uneconomical and can be maintained only for short periods of time. When airplanes are on air alert, direct air-ground communication with supported unit will be normal.

b. Period of operations.—The commander of the supported unit and his air support control must be thoroughly familiar with the importance of conserving the supporting air units by careful control of combat crew state of readiness. From experience gained abroad and in this country it has been established that, for continuous or sustained operations, an air support unit can operate for protracted periods, if not to exceed a ratio of about 25 percent of the combat crews are on alert status, 25 percent readiness status, and 50 percent released. It must also be borne in mind that as part of the unit is ordered out on missions other crews must replace those ordered out, and so advance their state of readiness. Combat crews on "alert" are seriously affected by fatigue due to the tension and discomfort of being in full flying gear and in immediate expectation of taking off. When an attack order comes in, personnel must be ready instantly to plan their attack, be briefed by intelligence, go to their airplanes, which are usually dispersed, check their equipment and take off. It should therefore be exceptional for combat crews to be held on alert status when there is no immediate prospect of missions being ordered. In all cases due consideration should be given to the conservation of combat crews as related to the immediate ground situation. For a decisive operation *limited in time,* the maximum number of aircraft should be placed in highest readiness status that contemplated employment will permit.

c. Limitations.—In this connection, it is important to consider the uncertainty of sustained strength in participating aircraft. Only the number available for initial operations can be definitely determined. Neither the numbers which will return, nor the time at which those that return will be available for future action, can be predetermined with any reliability. In these circumstances, the number of aircraft immediately available will, after the opening phase, fluctuate throughout the operation. This fluctuation is an important limiting quality of air support.

NIGHT OPERATIONS

■ 42. High altitude bombing can be conducted at night whenever the conditions are such that the target can be seen and the necessary sighting operations performed. Artificial illumination of the target is frequently necessary. For such attacks using the flight, squadron, and glide methods see FM 1–10.

■ 43. Minimum altitude bombing, usually by airplanes operating singly, can be effected against very profitable targets, such as motor and troop columns, which habitually operate under the protection of darkness. For night bombing operations see FM 1–10.

SAFETY MEASURES AND GROUND IDENTIFICATIONS

■ 44. Up to the present no satisfactory method has yet been developed that will insure immunity to troops from attacks by its own bombardment. However, the chances of bombing friendly troops can be held to a minimum and the chances of error reduced by careful attention to the following:

a. Briefing of combat crews.—Thorough and complete briefing of combat crews by unit intelligence officers prior to a mission, giving as accurate and up-to-the-minute picture of friendly ground activity and location as is possible before take-off.

b. Target designation.—Complete and detailed location and description of target with respect to prominent landmarks. Also direction and rate of movement of target or its probable movement. Pictures, drawings, and other helpful data should, if possible, be furnished to flight leaders.

c. Timely notification of situation changes.—Immediate priority advisement by ground commander to associated air support agency of any affecting changes in friendly troop dispositions occurring subsequent to a specific request for support mission.

d. Identification of enemy.—Thorough training and indoctrination of air and ground personnel in visual identification of enemy and friendly uniforms, matériel, formations markings, and signals. Provisions must be made by responsible commanders for combined training of air and ground troops, leading toward the development of satisfactory mutual iden-

tification methods in order to increase the effectiveness of their combined operations.

■ 45. IDENTIFICATION, FRIENDLY TROOPS.—Among the methods of identifying friendly troops and reducing chances of being bombed by friendly aircraft tried with limited success both in this country and abroad are—

a. Establishment of bomb safety lines readily identified from the air.

b. Visual signals prescribed to identify ground elements to friendly aviation. Examples of visual signals are panels, flags, pyrotechnics, lights, smoke, marking of vehicles, and arrangement of vehicles in certain formations.

c. Radio communication with aircraft in flight.

■ 46. Methods to identify friendly troops to friendly air units must constantly be sought and tested. These methods may be of a secret nature and should be incorporated in signal operation instructions.

CHAPTER 3

OBSERVATION AVIATION AND PHOTOGRAPHY

SECTION I

ORGANIZATION AND EQUIPMENT

AIRPLANE TYPES

■ 47. As an aid to an understanding of the organization of observation and photographic aviation, the succeeding paragraphs are devoted to a discussion of their characteristics and equipment.

■ 48. OBSERVATION TYPES.—*a.* At present there are two basic types of high performance airplanes used for observation purposes: the high performance two-engine multiplace type; and the high performance single-engine, single seater. Both of these types are designed or adapted primarily for observation missions although they may also be capable of air attack. Their speed will be sufficient to permit them to avoid action generally, but they will be sufficiently armed to give them some protection from hostile aircraft and partially armored to afford some protection against ground fire.

b. Liaison type aircraft are characterized by their slow speeds, lack of armor and armament, and by their ability to operate from relatively small areas.

c. Balloons for observation purposes have been discontinued.

■ 49. PHOTOGRAPHIC TYPES.—*a.* The primary function of a photographic airplane is the transportation of a camera or cameras in operating positions. Several types of aircraft will meet this requirement. Tactical requirements will generally be the determining factors in selection of actual types. These factors will generally be—

(1) Altitudes at which photographs are to be taken.

(2) Scales desired.

(3) Security.

b. Correlating these factors with the tactical requirements of photographic squadrons calls for aircraft of maximum

speed to operate at high altitudes with operations generally assured by superiority of armament, speed, maneuverability, or altitude. These four conditions complicated by the necessity for carrying cameras cannot all be attained to maximum degrees, therefore a compromise is reached giving the best combination for various conditions, generally speed and maneuverability at altitude, all of which are improved by the lack of armament.

■ 50. MAPPING.—The fundamental requirements for mapping type airplanes are the same as those for high altitude photography with the added requirement of longer range and ability to carry more and larger cameras.

ORGANIZATION

■ 51. GENERAL.—Observation aviation will generally be sufficiently decentralized to permit each corps and division to plan the use of and to call direct upon its supporting observation squadron for missions.

■ 52. UNIT ALLOTMENT.—Based on present Tables of Organization the allotment of observation aviation is—

a. Theater headquarters—One or more mapping squadrons.

b. Each army—An observation group, consisting of two medium observation squadrons and a photo squadron.

c. Each army corps—An observation group consisting of one medium observation squadron and one light observation squadron per division.

d. Each armored and cavalry corps—One observation squadron (M) and a medium observation group consisting of one medium observation squadron per division.

e. Force Headquarters, Armored Force—One photo squadron.

f. Each separate armored or cavalry division—One medium observation squadron.

■ 53. While generally each echelon depends upon the allotted observation indicated above, higher echelons, where the situation warrants, use their aviation to carry out missions for lower units, normally retaining centralization of control. Armored and cavalry divisions, due to the character of their

role and missions, have medium squadrons instead of the light squadrons allotted for the support of infantry divisions.

■ 54. NUMBER OF AIRPLANES.—*a. Observation.*—Each observation squadron has as its basic equipment 18 airplanes of suitable type. These types will vary according to the missions which each type squadron will be expected to perform.

(1) At the present time light observation squadrons have 6 high performance single-engine, single-seater type, and 12 liaison type.

(2) Medium squadrons have 6 high performance bimotor, multiplace type, 6 high performance single engine, single seater, and 6 liaison type.

b. Photo.—Photo squadrons are at present equipped with 6 bimotor, multiplace type, and 12 single-engine, single-seater type.

c. Mapping.—Mapping squadrons will be equipped with 18 long range extreme altitude airplanes as indicated in paragraph 50. Twelve of these are of the bimotor, multiplace type, and 6 single seaters.

FUNCTIONS

■ 55. OBSERVATION.—It is the function of observation aviation to support the ground units by the execution of reconnaissance, artillery, and liaison missions.

■ 56. PHOTO.—The primary function of photo squadrons is to accomplish all aerial photography required by the army, or armored force to which assigned, except the reconnaissance photography performed by observation squadrons. They will be able to perform a limited amount of mapping, but such functions are not normal and will seriously curtail their normal useful functions.

■ 57. MAPPING.—Mapping squadrons are constituted for the use of theater headquarters to perform mapping in any area which is likely to become of military interest. The services of mapping squadrons will not generally be required by or available to lower echelons as that work will have been previously accomplished. It should be normal to have a mapping squadron assigned to each oversea theater.

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SECTION II

OBSERVATION OPERATIONS AND MISSIONS

OPERATIONS

■ 58. LIAISON.—While the general value of observation aviation is widely recognized, the potentialities and limitations of equipment available, and the standard of training, indoctrination, and morale of personnel must be fully realized by the supported commander in order to exploit his observation aviation to the maximum without excessive losses. This calls for very close liaison between the supported commander and the observation aviation available to him. Such liaison is of sufficient importance that the observation unit commander will be designated as air adviser to the commander of the supported unit. He should take advantage of his position, particularly in the initial phases of operation, personally to advise the supported commander on these points. Thereafter he will generally desire to be represented by one of his most experienced officers who will have a very thorough personal knowledge of his particular unit, the commander continuing to act as air adviser to the commander of the supported unit making whatever personal contacts are deemed necessary.

■ 59. INTELLIGENCE.—*a. General plan.*—In order to insure intelligent execution of all observation missions, it is of the utmost importance that every pilot and observer be familiar with the general scheme of maneuver of the supported unit and with the details of every operation in which he may be called upon to participate. The plan of employment of other friendly operations both ground and air should be known to planning personnel to insure coordination. Close contact should be maintained with adjacent air units to permit rapid exchange of information vital to their operations.

b. Enemy situation.—It is important that pilots and observers keep posted on the enemy situation, both ground and air, not only for the intelligent execution of their mission but for their own safety. This knowledge enables them to determine more thoroughly the requirements of their mission than would be possible without it. Their safety is dependent upon their knowledge of the locations of ground installations which

might oppose the execution of their mission and enemy air activity which they might desire to avoid.

c. Intelligence officer.—In order to disseminate this information to pilots and observers, the intelligence section of the observation squadron must maintain information which is thorough, accurate, and up to the minute. In order to maintain this condition, it is necessary that the intelligence officer not only thoroughly understand the organization and operation of the supported ground elements, but that he have a general knowledge of the opposing ground forces. He must maintain very close liaison with the supported unit to get all information concerning friendly plans and situations and to keep himself posted at all times on the situations of both friendly and enemy ground forces. He must maintain contact with other air elements and any other sources available for information concerning both friendly and enemy air activity. He must keep all pilots and observers constantly informed of the general plans and situations, and upon request for a mission he must himself analyze it and brief his observation crews immediately prior to dispatching the mission. Upon completion of the mission he must receive all reports and interrogate the crews involved in order to transmit proper intelligence to the supported unit. He must have sufficient relief within his section to maintain constant operations and at the same time permit personal visits to the supported unit.

■ 60. ORIENTATION.—It is particularly important that pilots and observers in observation squadrons be thoroughly familiar with the terrain over which they operate in order that they will know at all times where they are, and be able to find their objectives by reference to landmarks while flying at low altitudes with the minimum reference to maps in flight. Orientation is important in locating and reporting observations. They should make a thorough study of the area beforehand to permit constant orientation without reference to maps particularly during darkness when the minimum number of landmarks are visible.

■ 61. ALTITUDES.—Only general rules can be stated regarding the altitudes at which observation missions can be performed. The most suitable altitude depends upon such factors as:

mission, performance and characteristics of the aircraft employed, armor and armament carried, range and effectiveness of hostile small arms fire from ground weapons, amount of effectiveness of antiaircraft fire, hostile air activity, camouflage of the airplane, and weather conditions such as the ceiling, visibility, and clouds. Considering terrestrial combat interference, operations of observation aviation over friendly territory is restricted only by the range depth of fire from hostile weapons on or close to visual front-lines. The weapons available to the hostile ground arms, then, will determine dangerous altitudes. Small caliber weapons are generally effective up to 5,000 feet elevation and larger calibers, including heavy antiaircraft weapons, to varyingly high altitudes up to 21,000 feet. Hence, the safest altitudes, considering only ground fire, are those above the largest caliber hostile weapons or below the altitude at which smaller ones may be used effectively. Similarly, while immunity from hostile air attack cannot be assured, safest altitudes are those overtopping the ceilings of hostile aircraft or zero altitudes which prevent hostile diving attacks.

■ 62. SORTIE.—While it would be possible under conditions of absolute air superiority for aircraft to exist above the range of hostile ground fire, such conditions of air superiority would be considered exceptional and of short duration. This imposes the restriction on the ground commander of requiring that he select definite objectives to permit observation airplanes to fly in at minimum altitude and maximum speed for a hasty observation and quick return. The mission of aerial surveillance in the face of even minor opposition should be exceptional.

OBSERVATION MISSIONS

■ 63. GENERAL.—Observation aviation operating in support of ground forces does not replace any of the intelligence agencies available to the commander of those forces, but supplements them and can provide the commander with information which he cannot secure by other means. Corps and division observation units will be trained and equipped for reconnaissance, artillery support, and liaison missions, and for such photographic work as may be required by the supported unit, particularly reconnaissance photography.

The army observation group because of its photo squadron will in addition be equipped and trained to furnish artillery fire control photographs and limited mapping photography.

■ 64. RECONNAISSANCE.—*a. Day.*—Complete control of the air may permit a detailed and deliberate visual reconnaissance of hostile territory by methods similar to those previously employed. However, it must be realized by all concerned that the nature and effectiveness of hostile air action are the controlling factors, and when operating against an enemy of approximately equal air strength, complete control of the air will seldom, if ever, exist. Ground fire and hostile aviation may require the performance of daylight reconnaissance missions in hostile territory at maximum speed either at minimum altitude or at relatively high altitudes. This will limit the effectiveness of visual reconnaissance and necessitate reliance upon photographic and night reconnaissance with a minimum time spent over hostile territory and will also require a careful selection of reconnaissance objectives. Missions will generally be carried out by making a series of brief sorties into enemy territory taking full advantage of high speed using clouds or irregularities of the terrain for cover.

b. Night.—Night reconnaissance is habitual and is productive of a great deal of valuable information, particularly to the experienced observer who is familiar with the terrain. Normal conditions will sometimes permit, without artificial illumination, the observation of activities which rely for their success upon the cover of darkness, such as troop and supply movements. Artificial illumination may permit closer examination when necessary. Even though information obtained by night reconnaissance may be meager, the moral effect on the enemy is considerable as he will be uncertain as to whether his movements have been discovered. (See FM 1–20.)

■ 65. MISSIONS FOR INFANTRY.—Missions performed for Infantry include the location of the opposing front lines, observation of the progress of combat, location of hostile resistance or enemy penetrations into our positions, and assembly of hostile troops for attack or counterattack. Commanders of all echelons of ground forces are interested in the progress of battle. It is the primary responsibility of the lower units of the ground forces themselves to furnish

this information to their commanders. When these agencies prove inadequate, observation aviation may be called upon to assist in obtaining this information. Before directing missions of this type, commanders should take into consideration the high casualty rate to be expected, and should balance this factor against the value of the information desired. Frequently a single sortie may be able to determine the desired information, in which case the mission should not be burdened with requests for additional reconnaissance.

■ 66. LIAISON MISSIONS.—Liaison missions are performed to provide the superior commander with information required in special situations and not obtainable through routine channels, or to transmit information or orders when such transmission can be more effectively accomplished by air messengers than by other means of communication. Where the situation permits, this mission may be performed by the liaison type airplane. However, all concerned must realize that this type airplane is extremely vulnerable to hostile ground and air fire; that normally it must be employed only over friendly territory; and that conditions of modern warfare may not provide a definite line of demarcation between hostile and friendly territory behind which such airplanes can operate. Additionally, while this airplane is designed to operate from small, unprepared fields, the latter may not be available.

■ 67. ARTILLERY MISSIONS.—Due to the inability in many cases of ground observers to locate targets and observe artillery fire, aerial observation is necessary. The liaison type airplanes may operate over friendly territory for the adjustment of artillery. Due to its extreme vulnerability, even to ground fire near the front lines, this type airplane must be looked upon more as an elevated observation post rather than an observation airplane for the adjustment of artillery. Enemy air activity will more readily curtail the use of this type airplane than the high performance observation type. With the realization of these factors, observation and artillery units must depend upon the normal high performance observation airplane to some degree for adjustment of fire. Long range artillery fire, deflade, and poor visibility may require that such adjustment be carried out over hostile territory. Proper planning and prearrangement must be

thoroughly considered for rapidity of adjustment to reduce to a minimum the time which the airplane spends over hostile territory. The use of suitable fire control photographs aids in such planning. For details concerning tactics and technique employed in artillery missions see FM 1–20.

■ 68. COOPERATION WITH CAVALRY.—Observation aviation does not replace or supplant Cavalry as a reconnaissance agency, but by proper cooperation increases the effectiveness of that arm by extending its radius of action and by directing attention to known or suspected hostile forces, thereby obviating useless marching and conserving men, horses, and matériel. Observation for Cavalry is particularly important in the initial phases of a strategic or tactical movement. During combat the observation aviation mission with Cavalry is essentially the same as that with Infantry.

■ 69. COOPERATION WITH ARMORED AND MOTORIZED FORCES.—The rapid movement of armored and motorized units calls for the use of observation aviation for distant and route reconnaissance, march liaison, observation for artillery, and normal liaison. Observation aviation is of vital importance in the operation of armored forces.

■ 70. COOPERATION WITH SEACOAST ARTILLERY.—In the organization of air support commands no observation aviation is specifically provided to serve seacoast artillery but occasions may arise wherein such may be required, in which case it will be provided by the appropriate air support commander as directed by the theater or army commander. Long range reconnaissance at sea for the discovery of targets is beyond the realm of the function of observation aviation operating on such missions, but it may be used for short range reconnaissance and for the adjustment of fire on targets. (See FM 1–20.)

■ 71. COOPERATION WITH COMBAT SUPPORT AVIATION.—On occasion, certain specified observation missions may be authorized to call directly to air support control, to airdromes, or to combat support aviation on air alert, for the purpose of reporting targets for combat support aviation. Observation missions may be dispatched primarily for the purpose of locating such targets. It should be noted that an observation mission authorized to make such requests for combat

air support is in the same status as a ground air support party. After it files a request and receives an approval it will, if desired, remain in surveillance until the arrival of the combat aviation which it then "leads in" to the target.

■ 72. COMMUNICATION METHODS.—*a.* Success of communication in observation aviation depends to a large degree upon constant use of the communication system involved by all personnel concerned. It is not sufficient that individuals be able to use the system but it is vitally important that all parties who are to communicate with one another constantly train and practice as a team. It must be recognized by commanders that responsibility for each complete communication system must be centralized rather than divided. Methods which necessitate cooperation between aircraft in flight and troops on the ground require constant practice and coordination to give any expectation of the success which will be necessary in operations.

b. There are a variety of methods of communication available to the observation team and ground units with which it is operating. Radio, while it is the most widely used, cannot always be considered reliable and must be supplemented by other means.

(1) *Radio.*—Radio is the normal means of communication for observation missions with artillery, armored forces, and combat support aviation and is relied upon generally in operations with other forces, particularly in higher echelons.

(2) *Dropped messages.*—The dropped message is an important and reliable means of communication which is particularly useful to deliver marked maps, photographs, or sketches, none of which can be transmitted by radio. This means may be used frequently on reconnaissance missions with more satisfactory results than radio; for communication with ground troops who have no other means available; to supplement radio on many missions; and as a satisfactory emergency means on others.

(3) *Panels.*—Simple prearranged codes may at times permit the use of panels as a valuable means of communication when others would not be practicable. Their use should be limited to single indicators as even moderately long messages are too time-consuming to be considered. They may be of

particular value in special operations such as those undertaken by parachute troops or detached raiding parties.

(4) *Pyrotechnics.*—These may sometimes be used for communication or identification.

(5) *Airplane maneuver signals.*—Simple signals may sometimes be transmitted by maneuvering the airplane in accordance with a prearranged code. Their primary use is for artillery missions but may be adapted to other uses.

(6) *Pick-up messages.*—Messages may be picked up by liaison type airplanes but such is not generally practicable with high performance type aircraft.

(7) *Miscellaneous.*—Frequently the most satisfactory and rapid procedure for reconnaissance missions will be to require that the observation team land at the end of a sortie to deliver photos for processing and to be interrogated by intelligence officers.

SECTION III

PHOTOGRAPHY AND MAPPING

PHOTOGRAPHY

■ 73. GENERAL. (See FM 1–35, 21–27, and 30–20).—*a.* Aerial photography cannot of itself win tactical advantages, but the failure to use aerial photography properly may result in the loss not only of battles but of a war. Aerial photography forms the basis for a large part of all intelligence. It is therefore essential that air and ground commanders have a clear idea of the capabilities and limitations of aerial photography.

b. A major use of aerial photography in an active theater is to secure information for the purpose of intelligence. It should be the normal custom for these same photographs to be used for terrain studies and map correction. However, the vital function is to provide information, either positive or negative, concerning the location and extent of enemy installations, supplies, vehicles, and troops.

■ 74. DISTRIBUTION OF AERIAL PHOTOGRAPHS.—All intelligence data, and particularly those obtained from aerial photographs, are of maximum value to the supreme commander and of diminishing value to his subordinates. However, to insure

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proper distribution in the minimum time, photographic units must distribute the information gained by aerial photographs to all interested headquarters simultaneously and not through the normal chain of command. The bulk of the photography will be primarily for intelligence purposes and the photographs themselves will not receive wide distribution. Furthermore the speed of production of aerial photographs is directly proportional to the number of prints made from each negative. If qualified liaison officers from the supported units are stationed with the photographic squadron of the command or with the G–2 with which that squadron operates, they may indicate the need for distribution of specific photographs to their units. It is the duty of these liaison officers to determine which of existing aerial photographs should be distributed to their units. It will usually be far more desirable to authorize the liaison officers to indicate the distribution desired in each particular instance, rather than set up hard and fast distribution. These liaison officers, being familiar with the immediate needs of their units, may also serve as a channel for the request for aerial photography.

■ 75. OPERATIONS.—*a. Day.*—The performance of required aerial photography during periods when there is friendly control of the air presents no particular problem other than that presented by the weather. However, it must be constantly borne in mind by supported units that, in the face of active enemy aerial opposition, it is suicidal to attempt to photograph a specific objective at regular intervals. Photographic aviation will depend upon speed, altitude, and the element of surprise in order to secure desired photography in the face of strong opposition. The office in charge of photographic operations must employ a great deal of ingenuity in avoiding any pattern in photographic flight over specific areas. It is quite practical to secure a strip of photographs of enemy area, utilizing surprise, speed, and extreme altitudes. It is thus possible, by careful planning of successive photographic flights undertaken primarily for intelligence photography, to secure overlapping coverages of wide areas.

b. Night.—A general exposition of night aerial photography is found in FM 1–35. Excellent results are produced with

artificial illumination under good visibility conditions although only a small area is covered with success, dependent upon the degree of accuracy in locating the desired area.

c. General.—Orders for photographic missions must be specific. At the altitudes at which missions are generally conducted in the face of active opposition, the photographic pilot cannot observe troops or installations upon the ground and then secure photographs. Instead, photography must be obtained on a specific strip of terrain without regard to the pilot's ability to see enemy installations, troops, etc. Photography secured in this fashion is capable of giving negative information as well as positive. While it is possible for a clever and ingenious enemy to camouflage and conceal his actions from visual observation, the camera cannot be fooled, particularly when a resultant photograph is studied by highly trained photographic interpreters.

MAPPING

■ 76. MAPPING SQUADRONS.—Special mapping squadrons are constituted for the use of theater headquarters. (See pars. 47–57.) They normally perform the mapping of large areas. Their operations should be planned to cover all areas of possible military action to permit the production of accurate maps as far in advance of the needs of the troops as practicable. In order to provide for maps or for map revision a mapping squadron will normally be provided for each oversea theater. Proper anticipation of mapping requirements will generally permit greater coverage with more satisfactory results without enemy opposition than is possible under conditions of actual hostilities.

CHAPTER 4

AIR TRANSPORT

SECTION I

GENERAL

■ 77. LIMITATIONS.—The movement of troops and their equipment and the movement of emergency supplies by air transportation are entirely practicable within the limitations of aircraft in general and the available types of airplanes and gliders in particular. The principal factors limiting the use of aircraft in air transport operations are—

a. Availability of suitable and sufficient aircraft and crews within the time limit allowed by the situation.

b. Performance characteristics, that is, speed, range, carrying capacity.

c. Ground facilities at points of departure, intermediate landing points, and points of destination.

d. Weather.

e. Enemy activities.

■ 78. PRACTICABILITY.—*a.* In the consideration of the use of air transportation, the importance and urgency of the operation must be weighed against the fact that this is the most expensive form of transportation available. It is expensive not only in money, but also in terms of fuel consumed, wear and tear on and possible destruction of the aircraft involved, and in the interruption in the performance of the normal missions of these aircraft for the time required. It is also expensive in terms of equipment and supplies for the transported troops. The amounts of these items accompanying the troops have to be held to a minimum and the troops are deprived of the use of the remainder until it can be brought to them at later times.

b. Air transportation is usually thought of in terms of its rapidity. However, it is faster than other methods only after the airplanes are under way. The coordinating and planning, movements to points of departure, and loading require fully as long as the older methods. The difficulty

of reaching an objective due to its geographical location and/or enemy activity, rather than the time element, will be the chief factor calling for the transportation of large detachments by air.

c. Various factors at present render it inexpedient to hold large concentrations of airplanes together for such movements. Thus any troop movement will have to be foreseen or delayed a sufficient time to permit the required aircraft to be assembled. At present, large troop movements by air, except to relatively inaccessible destinations, require an overall time interval comparable to or even longer than that for other means more immediately available.

■ 79. PLANNING.—The necessity for planning for air transportation operations in greatest detail and with thoroughness must be recognized if confusion, delay, and even disorganization are to be avoided. Such operations are more delicate than are similar ones by more conventional means. Efficient liaison between transporting and transported units is a prerequisite, and opportunities for rehearsal and practice should not be neglected.

a. Protection for the troop movements is a primary consideration for all concerned. Two major factors which contribute to such protection are secrecy of projected operations and friendly aviation.

b. Steps to maintain secrecy regarding large troop movements must begin with the inception of the plan so that reports of unusual concentration or activities involving transport airplanes, even those occurring in interior zones, will not reach the enemy. Actual flights should avoid thickly populated areas and preferably should be made at a very low altitude or at night.

c. Adequate pursuit protection must be arranged for. It is axiomatic that air superiority is a prerequisite to successful aerial troop movements.

SECTION II

TROOPS INVOLVED

■ 80. PARACHUTE TROOPS.—*a.* Parachute troops are specially organized for and trained in moving by air. Their equipment is such that no difficulty is experienced in carrying it

by airplane except that a certain number of the airplanes must have large "cargo" doors through which equipment bundles may be dropped in tactical operations. All airplanes carrying parachute troops must be equipped with a suitable longitudinal steel cable for the attaching of parachute "static" lines. Parachute troops provide their own parachutes. Strategical movements of parachute troops may or may not be made by air; tactical missions always involve air transportation.

b. Air transport operations involving parachute troops consist in carrying them to a jumping point over or near their objective, protecting them en route, and supplying their essential needs by air thereafter for as long as the situation demands or permits. Not infrequently bombardment support at the objective will be indicated.

■ 81. AIR-BORNE TROOPS.—*a.* Air-borne troops, other than parachute troops, will consist of the combat elements of ground units plus a minimum of essential service troops. In small scale operations, these troops will generally be from infantry units. Large scale operations will usually include combat elements of other arms and services. Parachutes for these troops will be supplied by transporting units.

b. Air operations involving air-borne troops other than parachute troops may be undertaken independently but usually will be made in conjunction with the parachute troops. Such operations will consist of transporting these troops to and landing them at their destination, protecting them en route, and providing a supply and evacuation service for as long as the situation demands or permits. Because of the necessity for landing the troops at their points of destination, both gliders and airplanes may be used.

SECTION III

TRANSPORTATION EQUIPMENT

■ 82. GENERAL.—Transportation equipment primarily consists of transport airplanes and gliders. Other types of airplanes such as medium and heavy bombardment may be used, but transport airplanes will usually be made available.

a. Present transport airplanes have seats for from 12 to 28 passengers, depending upon design. However, the number of passengers who may be carried depends upon the weight of engine fuel, baggage, equipment, and supplies which have to be carried in each airplane. Thus particularly in aircraft with large seating capacity, the number of soldiers carried may not equal the number of seats because of the essential accompanying items. The determination of the carrying capacity of the airplanes and consequently the number of airplanes for each particular operation is a technical task for the air staffs concerned. Aircraft are not standardized to the extent of other forms of transportation, and small variations in weight and size are important.

b. Present transport airplanes have medium cruising speeds ranging from 140 to 175 miles per hour depending upon design, can carry up to about 6,000 pounds, and can land in about 1,800 feet over a 50-foot obstacle. Capabilities of the aircraft will be reduced when gliders are being towed. Present transport airplanes carry no armament.

■ 83. GLIDERS.—Troop-carrying gliders have been constructed in the 8, 15, and 25 place sizes. Several of the smaller sizes may be pulled by one towing airplane. They are intended to be towed to and cast loose in the vicinity of their destination, and to glide to a landing. They carry no armament. Among the advantages possessed by gliders are their cheapness, rapidity of construction from materials readily obtainable, ease of maintenance and repair, silent approach, and slow landing speeds which enable them to land in small fields. Most of the problems involved in air transportation are common to the use of both airplanes and gliders.

■ 84. MAINTENANCE.—The air transport units must be accompanied by adequate maintenance, communication, and administrative personnel, and facilities. Aircraft for tactical troop movements must be in flying condition at the designated time and place, and in the designated number. Failure to achieve this will place the success of the maneuver in jeopardy from its beginning.

SECTION IV

OPERATIONS

■ 85. GENERAL.—Air transportation may be either of a strategical or tactical nature. In either case the basic problems of securing the airplanes and coordinating, organizing, planning, protecting, and conducting the movement are largely the same.

■ 86. COMMAND.—In most strategical and tactical movements, command of transporting units will usually be vested in the air support commander of the supported force with direct communication authorized between transporting and transported units. For operations of an independent and continuous nature, ground troops to be transported and the air transport units may be organized into an air-borne task force with the operational control of all components vested in the task force commander.

■ 87. FEASIBILITY.—When the necessity or desirability for air transportation arises, preliminary steps must be taken to determine if the operation is within the capabilities of aircraft and if aircraft of the desired types and in the desired number can be made available for the operation. In small operations where the use of airplanes of supporting aviation units is contemplated, these facts are readily ascertainable. However, large air transport operations will necessitate securing numerous airplanes from several sources.

■ 88. TRANSPORT ASSEMBLY.—Whenever practicable, airplanes for large troop movements should be concentrated far enough ahead of time to allow for preparatory organization and training for the movement. While permanently organized and well-trained air transport units should be provided insofar as is possible, some provisional organizations may have to be constituted. Transport airplanes on their normal cargo runs fly singly whereas troop movements require precision in take-offs, formation flying, and landings for efficiency and protection. In addition, parachute troop operations require that airplanes fly in special formations which may vary with each operation. Time spent in pre-operation training will do much toward insuring the success of the operation itself.

■ 89. COORDINATION.—*a.* As soon as possible after an air transport movement has been decided upon, qualified liaison officers should be exchanged between the transported and transporting units for the duration of the operation, and a conference between the commanders should be held. At this time a clear delineation of the activities and responsibilities of each should be understood.

b. The delineation of activities and responsibilities between transported and transporting units will include these points: The transporting unit will be responsible for the preparation of all plans pertaining to the use and allocation of the air force equipment and personnel in a manner as favorable to the desires of the transported units as technical and tactical conditions permit; the transported unit will be responsible for proper loading and unloading of personnel and supplies in accordance with plans provided by the transporting unit. The movement will be under the command of the transport unit commander during time of actual flight except that, when parachute troops are being carried, direction of individual airplanes may be temporarily relinquished to the jumpmasters on the final approach to the objective.

c. The commander of the troops to be transported should furnish the following information for each of his units to the air transport commander at their conference:

(1) Point or points of departure.

(2) Time of departure or arrival.

(3) Intermediate stops.

(4) Destinations.

(5) Method of movement, such as by one flight or by shuttling.

(6) Number of men to be carried and average weight of each including personal equipment. In movements likely to culminate in combat this information may be given in terms of numbers of combatant units, each composed of personnel, combat equipment, and supplies. These combat units should be standardized into a minimum of types. For example, a rifle battalion can be organized for the movement into two types of small units, one being similar to a rifle squad and the other being similar to an antitank squad. The composition of such units will be furnished. Each airplane will then carry whole multiples of these small units with remaining capacity devoted to other items.

(7) Weight of equipment and supplies to be carried.

(8) Information relative to equipment and supplies of unusual weight or bulk such as antitank weapons, reconnaissance, or other vehicles. Any object too large to be carried through an airplane passenger-size door is in this category.

(9) Information relative to type of formation to be flown.

(10) Information relative to the transportation of subsequent supplies to the troops during the course of operation, if such is contemplated.

(11) Information relative to practices or rehearsals desired.

■ 90. PLANNING, GENERAL.—After, or concurrently with, the foregoing conference, the air transport commander and his staff should proceed to plan the operation in great detail, This planning will include among other things the following:

a. The assembling of equipment, supplies, and ground personnel, and the assembly points therefor.

b. Signal communication.

c. Pre-operation training for the movement.

d. Movements of transport units to advanced bases.

e. Each troop-carrying phase of the operation as discussed in paragraph 91.

f. The movement of supplies as discussed in paragraph 94.

■ 91. PLANNING, DETAILED.—Troop movements must be planned in great detail and the information disseminated to those concerned early enough to be of use. The points covered should include the following:

a. A parking and loading plan at the point of departure. This plan should show the parking location of each airplane, its designated number for the particular operation, the pilot's name, and load to be carried, imposed upon a sketch or photograph of the field. Distribution of this plan should be made to air personnel and to the troops to be transported so that the latter will be able to locate and load the airplanes without confusion, or will be able to spot their personnel and equipment for loading prior to the arrival of the airplanes.

b. Plan of take-off and assembly into formations, distribution to include each pilot.

c. Flight formation plan showing the location of each airplane by number and pilot's name in each formation. Distribution of this should include the transported troops.

d. Flight plan giving routes, times, altitudes, speeds, and check-points for the flight, distribution to include each pilot.

e. Landing and unloading plan at destination. This should show the location of each airplane when stopped and ready for unloading at the destination, imposed upon a sketch or photograph of the landing area. Distribution should include the transported troops.

f. Signal communication instructions including visual air-ground signals at destination, distribution to include each pilot.

g. Enemy activities and installations.

h. Coordination of the air movement with friendly forces. Pursuit protection must be secured in sufficient strength to insure air superiority en route to and from the destination. The movement must also be coordinated with other friendly aviation assisting the operation and with antiaircraft units in the flight path.

i. Means for regulating the movement. Positive means must be provided for insuring adherence to the flight plan and for maintaining flight discipline during the air movement.

j. Special instructions applicable to the situation such as action to be taken in case of enemy attack, unexpected enemy resistance at the objective, alternate friendly airdromes, and instruction in regard to alternate objectives or crash landings at destinations.

■ 92. In view of the hazardous nature of even the initial phase of an operation of this kind, every effort should be made by all concerned to avoid last minute changes in plans. Such changes usually result in much additional work for the air units involved and may easily lead to delay and confusion, if not jeopardy. Some last minute changes are probably inevitable in field operations, but they should not be due to lack of study or foresight.

SECTION V

EMERGENCY SUPPLIES BY AIR

■ 93. In general, the same limitations and fundamentals of procedure and planning that govern the movement of personnel also govern the emergency movement of supplies by air, except where obviously inapplicable. (See pars. 89–92.)

■ 94. METHODS AND PRACTICE.—Emergency supplies may be delivered at their destinations by dropping, in gliders, or by airplanes landing.

a. The delivery of supplies by dropping may be the most practicable means in the situation to be met but is in every way a laborious procedure. Supplies to be dropped have to be strongly and carefully packed in bundles of limited size, dropping equipment is required for most articles, a portion of the supplies dropped will probably be damaged or irrecoverable by the recipients, and facilities available will usually limit the quantities which can be delivered in this manner.

b. Certain items may be dropped free without damage. Other supplies may be dropped free with the expectation of and allowance for some loss and damage. Such supplies should be packed in several layers of canvas, in several sacks, or in strong crates so that the contents will not be scattered when the bundles land.

c. Supplies to be dropped by parachute should be packed in bundles weighing approximately 200 pounds. Special equipment parachutes and containers have been developed but if these are unavailable, personnel parachutes with an arrangment for pulling the rip cords can be used.

d. When possible, prearranged visual signals should be used to identify the ground troops, to indicate the dropping field, to signify an intention to drop supplies, an affirmative, and a negative signal. When such communication has been arranged, supplies will not be dropped until an affirmative signal has been received from the ground.

e. The dropping field preferably should be flat with minimum dimensions of 30 by 100 yards and free of obstructions. To insure greater accuracy, bundles will be dropped at the minimum altitude from which the parachute will operate and with the airplane at slow speed.

f. Recipients must take precautions to avoid injury to personnel and equipment by falling bundles. Parachutes, containers, and other dropping equipment shall be taken care of properly and returned to the transporting unit.

■ 95. BY GLIDER.—Gliders may be used for delivering emergency supplies with all the advantages peculiar to that type aircraft. Particularly are they valuable because of their

comparatively large carrying capacity and their ability to land in comparatively small areas. Signal arrangements similar to that described in paragraph 94*d* are desirable.

■ 96. BY AIRPLANE.—Where landing areas are available and enemy activity permits, airplanes may deliver emergency supplies in normal manner and the problem is correspondingly simplified.

SECTION VI

AIR AMBULANCES

■ 97. Evacuation of sick and wounded personnel by air will often be necessary. If specially designed air ambulances are not available, ordinary transport airplanes with necessary improvisations may be used. In the latter case the number of litter, in contrast to the number of ambulant patients, must be included in the information furnished the transport commander.

■ 98. In movements of this kind, close coordination and cooperation should be effected with the medical units involved.

■ 99. Airplanes used exclusively for carrying sick and wounded personnel will be marked in accordance with international law.

SECTION VII

TARGET AND TRACKING

■ 100. Tow target detachments may be assigned to air support commands. The mission of these detachments is to provide aerial targets for the antiaircraft training of ground troops. They accomplish this by providing airplanes for antiaircraft artillery tracking missions, by towing targets for antiaircraft firing practice, and by the use of radio controlled targets.

CHAPTER 5

SIGNAL COMMUNICATION

SECTION I

GENERAL

■ 101. PURPOSE.—This chapter prescribes the responsibility for the establishment of signal communication between the several echelons of combat aviation comprising an air support command. It also describes the communication nets to be established, the allotment of radio sets to the various echelons, and methods to be employed in communication within an air support command.

■ 102. TROOPS.—*a.* Signal Corps troops are responsible for the establishment of communication at an air support command headquarters and to attached, auxiliary, and immediately subordinate units, including the headquarters of a supported ground unit. They are responsible for the establishment of communication with adjacent units as directed by the common superior headquarters. They are also responsible for the installation and maintenance of long trunk wire circuits, but not the terminal equipment attached thereto, between combat aviation groups and squadrons of an air support command, and subordinate, attached, adjacent and auxiliary units, as well as supported ground units, of such groups and squadrons, when the respective command posts are not adjacent or located in the same airdrome.

b. Army Air Force troops of the communication sections of combat aviation groups are responsible for the establishment of all communication at a group headquarters, including all echelons thereof, and to attached, adjacent, auxiliary, and immediately subordinate units, including communication with the headquarters of a supported ground unit, except as modified with respect to the installation and maintenance of long trunk wire circuits by the provisions of *a* above.

c. Army Air Force troops of an air support communication squadron are responsible for the operations of air support controls and air support parties, all having to do with initiating requests for air support, the evaluation of such requests, and the transmission of orders directing air support attack missions from an air support control to a bombardment aviation airdrome. Air support communication squadrons are separate units, one of which is attached to a bombardment group when the latter is engaged in air support operations.

d. Army Air Force troops of the communication sections of combat aviation squadrons are responsible for the establishment of all communication at a squadron headquarters, including all echelons thereof, and to all surrounding squadron installations, including communication with the headquarters of a supported ground unit, except as modified with respect to the installation and maintenance of long wire circuits by the provisions of *a* above. Army Air Force troops of the communication unit of a squadron are also responsible for the operations of an air support control when a squadron is in support of a ground unit.

■ 103. SIGNAL MEANS AND AGENCIES.—*a. Wire communication.*
- Telephone.
- Teletype.
- Tone telegraph.

b. Radio communication.
- Telephone.
- Telegraph.
- Radio intelligence.

c. Visual communication.
- Pyrotechnics.
- Panels.
- Airplanes.

d. Sound communication.

e. Pigeon communication.

f. Message centers.

g. Messenger communication.
- Dismounted messenger (local runner).
- Motor messenger.
- Airplane messenger.

■ 104. SIGNAL COMMUNICATION POLICIES.—*a.* Wire communication will be the primary means of communication between ground stations, except between air support parties and an

air support control, when radio will be used exclusively. Among the several types of wire communication, teletype will take precedence.

b. Of necessity, radio will be the primary means of communication between aircraft in flight and between aircraft and ground stations. For communication between ground stations, radio will be a secondary means of communication except as noted in *a* above.

■ 105. REFERENCES.—Reference is made to FM 1–45 for a detailed discussion of the tactics and technique of signal communication employed in air support operations.

SECTION II

COMMUNICATION NETS

■ 106. WIRE NETS.—*a.* The establishment of wire communication will be normal—

(1) Between an air support command headquarters and immediate subordinate combat aviation units.

(2) Between an air support command headquarters and the headquarters of attached, auxiliary, and adjacent units.

(3) Between an air support command headquarters and the headquarters of a supported ground unit.

(4) Between a combat aviation group headquarters and immediate subordinate combat aviation units.

(5) Between a combat aviation group headquarters and the headquarters of attached, auxiliary, and adjacent units.

(6) Between a combat aviation group headquarters and the headquarters of a supported ground unit.

(7) Between a combat aviation squadron headquarters and the headquarters of a supported ground unit.

(8) Between an air support control and bombardment aviation airdromes.

b. Over these wire nets, telephone communication will be possible over varying distances up to 20 miles. For more distant communication reliance must be placed upon teletype communication. Tone telegraph will be substituted for telegraph in the event of equipment failure on the part of the latter or of the existence of line conditions rendering teletype inoperative.

■ 107. RADIO NETS.—*a.* The following radio stations to work in radio nets as designated may be established by an air support command headquarters, and equipment to the extent of four radio sets is provided for the same with a fifth set as a reserve:

(1) A bombardment group net.

(2) An attached pursuit aviation net.

(3) An observation group net.

(4) A supported ground unit and higher air unit headquarters net.

(5) An air support control net.

(6) An air transport net.

It is highly improbable that all of these nets would be in operation at one time.

b. The following radio stations to work in radio nets as designated may be established by a combat aviation group headquarters when engaged in air support operations:

(1) A subordinate squadron net.

(2) A supported ground unit net.

(3) A superior air headquarters net.

(4) An air support control—air parties net.

(5) An air support control—bombardment airdrome net.

(6) An air control—bombardment aircraft in flight net.

(7) An air support party—bombardment aircraft in flight net.

These nets would not all be in operation at one time, and the employment of extra radio receivers which are made available with each radio set would serve to limit the number of radio transmitters required. There is available to a bombardment group when engaged in air support operations, and an air support communication squadron is attached to the group, a total of 10 radio sets, which are deemed sufficient to equip a maximum of four air support parties with 1 set each and one air support control with 2 sets, leaving 4 sets for purposes of working in other nets designated and to provide a limited reserve.

c. A combat aviation squadron is provided with a radio set to work in the net of its immediately superior unit's headquarters, and with another set to establish an air support

control in the event it is immediately supporting a ground unit.

d. Bombardment aviation net.—(1) After bombardment aviation takes off from its airdrome under orders received from an air support control, air-ground communication is normally maintained between the bombardment aviation in flight and the air support control. Usually a separate radio set, complete as to transmitter and receivers, is required, consequently the air support control is provided with two sets.

(2) At times it may be desired to turn over to an air support party control of the bombardment aircraft in flight for the purpose of guiding the latter to their target objective. In such event the one radio set with the air support party will suffice for these operations in addition to others that are normal. However, should it be foreseen that an extra radio set is required by an air support party, for the particular purpose described, one of the reserve sets of the bombardment group can be so employed.

e. Observation aviation net.—The attachment of the observation aviation of an air support command to units of the supported ground force is normal. However, the necessity will arise at times to establish an air-ground observation net at the air support command or subordinate combat aviation unit headquarters. It will be possible under any circumstances to maintain a listening station at any of the combat aviation unit headquarters to copy essential traffic of the normal air-ground net of the observation aviation and the ground unit headquarters to which the observation aviation is attached. The information thus to be gained will prove helpful to the several staff sections of a combat aviation unit headquarters.

f. Air transport net.—In the event transport aircraft is assembled as part of an air-borne force, the control of such aircraft in flight while transporting troops or supplies in accordance with the plan or orders of a directing ground unit devolves upon the air support commander. It will usually be necessary to establish a separate radio liaison net for this purpose which net will include, in addition to the command ship of the air transports and the air support command post, any or all of the following headquarters and

establishments, necessitated in part by the communication requirements of the air transports:

(1) The transport airdrome.

(2) Any intermediate landing fields between the transport airdrome and the final air-borne mission objective.

(3) The combat area (after first echelon of troops has been landed).

(4) The airdrome of accompanying fighter pursuit.

SECTION III

METHODS OF OPERATION

■ 108. WIRE COMMUNICATION.—Telephone communication should be limited to command purposes and employed only between commanders directly and the operation sections of staffs. Reliance will be placed upon the teletype as the primary means of wire communication.

■ 109. AIR SUPPORT PARTY—AIR SUPPORT CONTROL OPERATIONS.—*a.* Air support parties and air support controls are components of an air support communication squadron, which is attached to a bombardment group when the latter is engaged in air support operations.

b. An air support party is an air organization comprising an air support officer together with radio equipment and personnel detailed from a combat aviation unit, usually a group, to the headquarters of a supported ground unit for the purpose of transmitting to an air support control approved air support requests. Within an army corps an air support party is rarely detailed to a subordinate ground unit headquarters below that of an infantry division. Within the armored forces, air support parties will frequently be detailed to the headquarters of any subordinate unit of an armored division. The same is true with respect to the assignment of air support parties to a cavalry division. An air support party transmits to an air support control only such air support requests as have been approved by the commander of the unit at the headquarters of which the air support party is detailed. Communication between an air support party and an air support control is always direct. Radiotelegraphy is the means of communication employed.

c. An air support control is an air organization comprising the commander of the supporting combat aviation together with signal equipment and personnel, set up at the head-

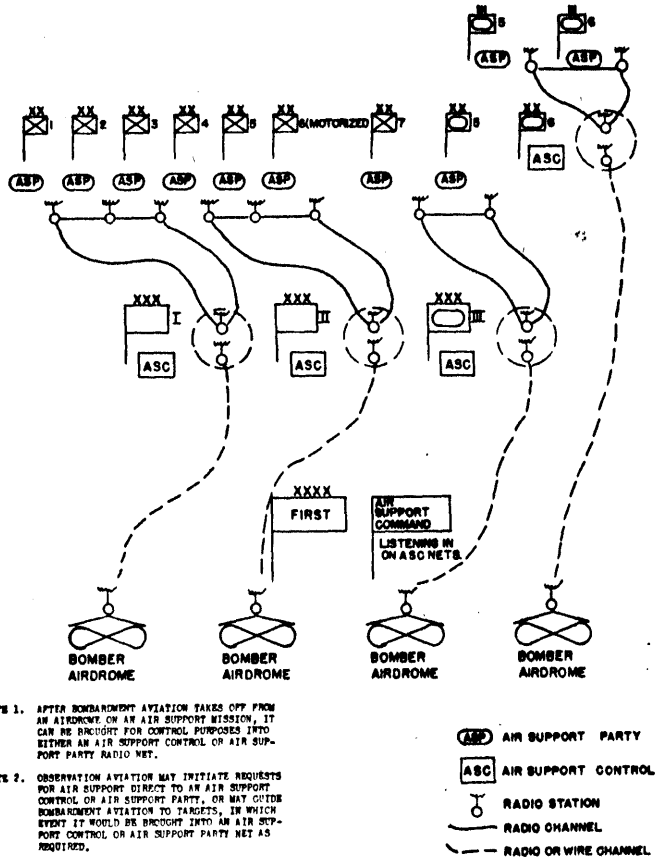

FIGURE 2.

quarters of a supported ground unit for the purpose of evaluating air support requests received from air support parties with which it is working and making decisions on requested

air support missions in consonance with the directive of the supported ground unit commander. Within the army corps, an air support control is normally established at the corps headquarters. Within an armored corps or cavalry corps, an air support control may be established at the corps headquarters, or at armored or cavalry division headquarters according to the plan of operation and assignment of air support parties. The establishment of one air support control only within a ground unit directly supported by a combat aviation unit will be normal. Communication between an air support control and bombardment aviation airdromes to which orders for the flying of bombardment missions are directed by an air support control will be either by radiotelegraphy or teletype according to circumstances.

d. Figure 2 presents a type operations plan for the air support controls and support parties of different major units of the ground forces. On the left side of the diagram are shown two army corps at the headquarters of which an air support control is operated. Air support parties are detailed to each infantry division headquarters. On the right side is shown an armored corps, at the headquarters of which an air support control is operating with two air support parties, one each at the headquarters of a motorized and armored division, respectively. At the headquarters of the third division, an armored division of the same armored corps, an air support control is operating with air support parties at each of two armored regimental headquarters. It is to be noted that in this latter instance, the air support control operates directly to a separate bombardment aviation airdrome indicating support of this division directly by a combat aviation unit.

e. As indicated in paragraph 107*d*, an air-ground net between bombardment aircraft in flight and either the air support control or an air support party may be established for the purpose of controlling the bombardment mission and assisting in guiding the aircraft to their target. Observation aviation may also be used in guiding bombardment aircraft to their target when the former would also come into this net.

■ 110. AIR ALERT STATUS.—When for a particular operation, bombardment aircraft may be put on air alert in support of a designated ground unit, requests for air support would then pass directly from the ground unit to the supporting bombardment aircraft in flight. Observation aviation may also be used in such an operation when it could be arranged that requests for air support pass directly from the observation aviation to the bombardment aviation in flight over an air-air net.

■ 111. RADIO EQUIPMENT CHARACTERISTICS.—Each radio set issued to units of an air support command includes three separate receivers which permit the guarding of several radio channels simultaneously at any one radio station. In addition the radio transmitters permit of rapid and precise shifting from one frequency channel to another which results in a high degree of flexibility in radio communication.

■ 112. VISUAL COMMUNICATION.—There are many uses for visual signals in an air support command, especially between the ground troops and aircraft in flight. Insofar as the ground troops can assist in directing friendly bombardment aviation to hostile targets, and as a measure to assure their own protection from bombardment by our own aviation, the use of panels or other visual signals must be resorted to. Consequently it is most important that all interested personnel of both the ground and air forces working together be thoroughly trained in the use of the several means of visual communication.

■ 113. SIGNAL OPERATION INSTRUCTIONS (SOI).—These are technical instructions for the coordination of the operation of the several means and agencies of signal communication. Their preparation and coordination with the signal operation instructions of the supported ground unit is a responsibility of the signal officer of the air support command, but it is incumbent upon all officers as well as interested enlisted personnel to be familiar with their purpose and use. No communication system can function efficiently without an intelligent understanding and use of signal operation instructions, and training in their employment.

SECTION IV

PREARRANGED MESSAGE CODE FORMS

■ 114. PREARRANGED MESSAGE CODE FORMS.—*a.* The use of such forms has particular application with respect to communication between air support parties and air support control, and between the latter and the airdromes of the bombardment aviation. Speed in the transmission of such messages is of primary importance, whereas, due to the comparative brevity of elapsed time between initiation and completion of any one air support operation, extensive cryptographic security is of secondary consideration. Every effort, however, will be undertaken to assure such security consistent with requirements for speed.

b. Due to the diversity of situations to be found in air support command operations, much latitude is permissible in the preparation of prearranged message code forms. The examples set forth herein as applicable to operations involving air support parties and air support control units, and bombardment aviation airdromes, are intended for guidance only.

(1) *Air support request form* (fig. 3).—This form is intended for use by air support parties in the transmission of requests for air support to an air support control unit.

(2) *Acknowledgment report form* (fig. 4).—This form is used by the air support control to acknowledge receipt of messages from the air support parties, and to designate whether or not particular requests for air support will be granted or denied.

(3) *Attack order form* (fig. 5).—This form is used by air support control in issuing orders to the bombardment aviation for air support missions.

(4) *Departure and return message forms* (fig. 6).—These forms are used by bombardment aviation units in reporting to the air support control departure from the airdrome on assigned missions, and return to the airdrome therefrom. Similar or modified forms can be used to report such departure and return of bombardment units to the interceptor command as required. In such instances prior coordination with interceptor command is necessary.

(5) *Notification of attack by enemy aviation form* (fig. 7).—This form is used by airdromes in reporting attacks by enemy aviation to the air support control or other headquarters concerned.

(6) In the use of prearranged message code forms of the type shown, it is contemplated that geographic codes and map coordinate codes or the coded template will be employed in designating the location of targets or other terrain points. As a further security measure, the letter symbol designating the several items of information transmitted, and the sequence of the information items themselves in the body of the message, should be changed at irregular and not infrequent intervals, and new forms published accordingly to all elements concerned.

c. Aircraft status reports.—Due to the variety of specific information required by these reports as between various commands, no example of the same is shown herein. A form for such reports can, however, easily be prepared using the same fundamentals as those that are contained in the forms exhibited.

d. Prearranged message code forms are properly a part of the signal operation instructions and their use and distribution, and all changes therein, will be coordinated through this agency.

AIR SUPPORT REQUEST

Time filed ..... How spent .....

	RNO ..... From ..... (Request No.) (Call letter ASC) (Call letter ASP)
Number support units required.	U—
Description of target....	T—
Location of target.....	L—
Probable movement or change in target.	P—
Time limits of attack....	H—
Other information or special instructions.	X—
Signature.....	R— ..... Signature

NOTE.—Transmit information contained within solid lines.

FIGURE 3.

ACKNOWLEDGMENT REPORT

Time filed ..... How sent .....

..... from	
(ASP)	(ASC)
RNO	.....
	.....
	Signature

NOTE.—Transmit all within solid lines.

FIGURE 4.